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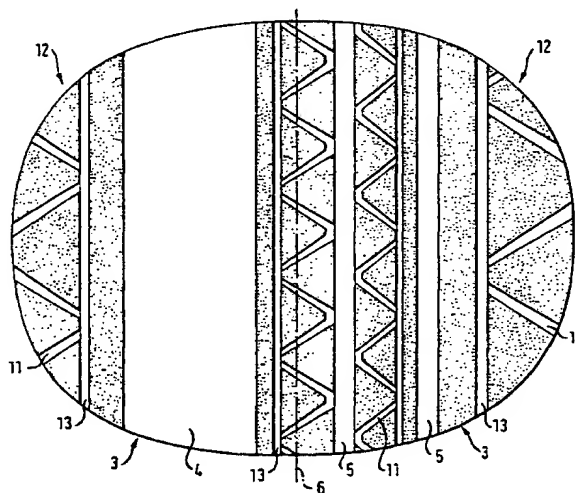
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(54) Title: **VEHICLE TYRE**



(57) Abstract: A vehicle tyre having a non-uniformly profiled tread with respect to its centre, with a circumferential extending superwide groove having a width of at least 30 mm provided in one half of the tread and two further circumferential grooves which are narrower in comparison thereto and which have at most a width of 15 mm being provided in the other tread half.

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VEHICLE TYRE**TECHNICAL FIELDS**

The invention relates to a vehicle tyre having a non-uniformly profiled tread with respect to its centre.

In the design of the tread pattern of vehicle tyres an attempt must always be made to take account of a plurality of partly mutually contradicting requirements, such as for example the aquaplaning or hydroplaning behaviour, the tread wear, the noise generation, the handling characteristics and the like.

BACKGROUND ART

It is known to design the tread patterns with broad grooves to improve the aquaplaning behaviour, in particular with a very broad groove at the centre of the tread or with two comparatively broad grooves on both sides of the centre of the tread. These known tread designs are, however, associated with the disadvantage that the improvement of the aquaplaning or hydroplaning behaviour, associated with the broadening of the circumferential grooves, leads to a deterioration of characteristics which are important in the same manner for the assessment of the relevant tyre, such as above all the handling and the noise generation and/or the passing noise.

The object of the invention is to so design the tread of a vehicle tyre while generally ensuring good handling characteristics that at the same time provide a very

good aquaplaning or hydroplaning behaviour and low passing or passing-by noise.

DISCLOSURE OF THE INVENTION

According to the invention there is provided a vehicle tyre having a non-uniformly profiled tread with respect to its centre, characterised in that one tread half, in particular the inwardly disposed tread half related to the vehicle, has at least one circumferential superwide groove having a width of at least 30 mm and the other tread half, in particular the outwardly disposed tread half, has at least two narrower grooves in comparison thereto which likewise extend over the tyre circumference, with the superwide groove being at least twice as broad as the broadest of the narrower grooves.

Through the combination of a super-wide circumferential groove disposed in one half of the tyre tread with at least two narrower grooves in comparison thereto which are disposed in the other tread half, one succeeds, in surprising manner, in ensuring a good aquaplaning behaviour with a low passing noise, in particular avoiding the feared so-called organpipe noise when using circumferential grooves, i.e. the occurrence of resonant frequencies in the 1 kHz range.

The width of the superwide groove preferably amounts to at least approximately 30 mm and in particular to more than 35 mm, whereas the narrower grooves have a width of 15 mm or less, more preferably 10 mm and less.

Extensive freedom exists with respect to the tread design using grooves and fine cuts or sipes in the raised tread

surface regions between and to the side of the circumferential grooves. Grooves extending obliquely with respect to the circumferential plane of the tyre, are, however, preferably used in order to avoid the striking of edges of the grooves in the tread contact patch. Fine cuts or lamella cuts can, however, also be provided extending in the transverse direction.

In the overall design of the tread pattern, attention should be paid to the fact that the positive component of the tread in the outer region is larger than in the inner region with respect to the vehicle in order to take account of the handling behaviour.

In accordance with a preferred embodiment of the invention, at least the narrower circumferential grooves are connected to one another by continuously curved grooves which extend obliquely with respect to the central plane of the tyre and which preferably extend from the tyre shoulder up to and into the vicinity of the superwide groove, with their inclination relative to the circumferential direction decreasing towards the tyre shoulder.

BRIEF DESCRIPTION OF DRAWINGS

Further advantageous variants of the invention are set forth in the subordinate claims and will be explained in the description of embodiments with reference to the drawing, in which are shown:

Fig. 1 the tread contact patch of the vehicle
 tyre tread pattern formed in accordance

with the basic concept of the present invention;

- Fig. 2 a tread contact patch in accordance with Fig. 1 with additional patterning;
- Fig. 3 a tread contact patch in accordance with Fig. 1 with a further variant of an additional patterning; and
- Fig. 4 a plan view of a section of a tread pattern in accordance with the invention.

MODE FOR CARRYING OUT THE INVENTION

Fig. 1 shows a tyre contact patch of a vehicle tyre in accordance with the invention, with the inwardly disposed tread half with respect to the direction of vehicle travel being characterised by the reference numeral 2 and the outwardly disposed tread half with the reference numeral 3. The vehicle tyre of the invention has circumferential grooves 4, 5 on both sides of the central plane 6 of the tyre, with it being important that two types of such circumferential groups are used, namely a superwide circumferential groove 4 and, in comparison thereto, significantly narrower circumferential grooves 5. The superwide circumferential groove 4 is arranged away from the centre 6, and indeed preferably in the inwardly disposed tread half 2. The width of the superwide circumferential groove should amount to at least 30 mm and will, as a rule, lie in the range between 35 and 50 mm.

The less wide circumferential grooves 5, which can have the same or also differing widths from one another, should have a width smaller than approximately 15 mm and lie preferably in the range from 12 to 4 mm.

In the embodiment of Fig. 1 the spacings of the respective inwardly disposed side walls 7, 8 of the superwide groove 4 and of the groove 5 adjacent to it from the central plane 6 of the tyre are selected to be at least substantially the same.

Fig. 2 shows the tyre contact patch in accordance with Fig. 1, with additional oblique grooves 11 and additional circumferentially extending narrow grooves 13 provided in the groove free regions and with their widths being significantly smaller and preferably at most half as large as the width of the circumferential grooves 5 associated with the superwide circumferential groove 4 and with them preferably being located in the tread half at the outer side of the tyre.

Through the inclined grooves a structure of inter-engaging, approximately equally sized, triangular blocks is provided in the central tread region, with the grooves communicating with at least one circumferentially extending groove and thus assisting the water dissipation in the tread contact patch in the region of the narrow grooves 5, 13.

The shoulder regions 12 are designed in such a manner that they have a relatively high positive component of tread pattern, in order to ensure the required handling behaviour. In the illustrated embodiment a narrow circumferential groove 13 and inclined grooves 11, which respectively communicate therewith and extend to the outer edge of the tread contact patch, are respectively provided in these regions, with the narrow grooves 11 preferably diverging to the outer edge of the shoulder regions.

The embodiment of Fig. 3 is distinguished from the embodiment of Fig. 2 in that the shoulder regions are subdivided by inclined grooves of lower width or lamella cuts into individual blocks and thus a particularly high positive component is present, whereas the superwide groove 4 and the two narrower ribs 5 which are disposed on both sides of the central circumferential plane 6 communicate with one another by inclined grooves which leads to the formation of substantially triangular blocks.

As already mentioned, the combination of a superwide groove with at least two narrower circumferential grooves is of importance for the invention, whereas the additional tread pattern design permits a large number of variants.

Fig. 4 shows a specific example of a tread pattern design with a superwide groove 4 disposed in one tread half related to the circumferential plane 6 of the tyre and with two further circumferential grooves 5 arranged in the other tread half and having a width which respectively amounts to less than one third of the superwide groove 4, which has a minimum width of approximately 30 mm.

The circumferential grooves 4, 5 are, as a rule, formed as straight grooves, can, however, have a shape which deviates from the straight shape, for example an elongate wave or zigzag shape. The side walls of the circumferential grooves 4, 5 are slightly inclined and, in accordance with a preferred embodiment, the superwide groove 4 has a plateau 9 in its central region which is bounded on both sides by recessed regions 10.

The positive component of the tread provided with the superwide groove 4 and the narrow grooves 5 in comparison thereto is loosened up or subdivided into blocks by grooves 11 and fine cuts 14, the boundary edges of which extend in particular at an acute angle to the circumferential plane 6 of the tyre in the region between the tyre shoulders.

As can be seen from the illustration of Fig. 4, the grooves 11 are continuously curved over their length, with a part of these grooves 11 extending, starting from the tyre shoulder 14, in the form of a curved arc over the narrower circumferential grooves 5 up to the superwide groove 4 and being led back again to the starting shoulder region while retaining or enlarging the curvature. Grooves 14 curved in this manner are so offset relative to one another in the circumferential direction of the tyre that at least two similar half arc grooves are intersected by the half arc formed by a continuous grooves. Oppositely curved part grooves can branch off from these arcuately formed grooves 11 while forming a symmetrical design, with in each case two adjacent part grooves of this kind crossing each other and ending with a spacing from the circumferential grooves 4, 5.

The depths of the grooves 11 preferably differs over their length; however, the maximum groove depth of the superwide groove is as a rule always somewhat smaller than the depth of the circumferentially extending grooves 4, 5. Only in the shoulder regions 12 are the grooves 11 conducted in such a manner that block edges extending perpendicular to the central circumferential plane 6 result in a comparatively narrow outer region. Otherwise it is ensured, by the selected groove layout, that all

the block edges which arise through the grooves extend obliquely to the central circumferential plane 6, so that striking edges which could increase the noise level are avoided.

CLAIMS

1. Vehicle tyre having a non-uniformly profiled tread with respect to its centre (6), characterised in that one tread half, in particular the inwardly disposed tread half (2) related to the vehicle, has at least one circumferential superwide groove (4) having a width of at least 30 mm and the other tread half, in particular the outwardly disposed tread half (3), has at least two narrower grooves (5) in comparison thereto which likewise extend over the tyre circumference, with the superwide groove (4) being at least twice as broad as the broadest of the narrower grooves (5).
2. Vehicle tyre in accordance with claim 1, characterised in that the width of the narrower grooves (5) is 15 mm or less.
3. Vehicle tyre in accordance with claim 1, characterised in that the superwide groove (4) has a width of at least 35 mm and in that the width of the narrower grooves (5) amounts to 10 mm or less.
4. Vehicle tyre in accordance with claim 1 or 3, characterised in that the grooves (4, 5) extending in the circumferential direction are substantially straight grooves.
5. Vehicle tyre in accordance with claim 1 or 3, characterised in that the spacings from the centre of the tyre of the respective inwardly disposed side walls (7, 8) of the superwide groove (4) and of the groove (5) adjacent to it in the outwardly disposed tyre tread half (3) are at least substantially the same.
6. Vehicle tyre in accordance with claim 1 or 3, characterised in that the superwide groove (4) is disposed in the inner half of the inwardly disposed tread half (2).

7. Vehicle tyre in accordance with claim 1, characterised in that the superwide groove (4) has a varying depth when considered over its width.

8. Vehicle tyre in accordance with claim 7, characterised in that the base of the superwide groove (4) has a plateau (9) in the central region which is bounded on both sides by deepened regions (10).

9. Vehicle tyre in accordance with claim 1 or 3, characterised in that the superwide groove (4) in the inwardly disposed tyre tread half (2) has a width of approximately 40 mm and two circumferential grooves (5) with a width of approximately 8 mm in each case are provided in the outwardly disposed tyre tread half (3).

10. Vehicle tyre in accordance with claim 1 or 3, characterised in that the tread regions between the grooves (4, 5) and to the side of the grooves (4, 5) are provided with grooves (11) and/or fine cuts which extend obliquely to the circumferential direction of the tyre at least outside of the tyre shoulder regions (12) and preferably with changing inclination.

11. Vehicle tyre in accordance with claim 1, characterised in that the circumferential grooves (4, 5) are connected together at least in part by oblique grooves (11).

12. Vehicle tyre in accordance with claim 11, characterised in that the inclination of the oblique grooves (11) relative to the tyre circumferential direction reduces towards the tyre shoulders (12).

13. Vehicle tyre in accordance with claim 1 or 3, characterised in that the grooves (11) extending obliquely to the circumferential direction of the tyre have different depths over their longitudinal extent and in particular a depth which increases or first increases and then reduces towards the tyre shoulders (12).

14. Vehicle tyre in accordance with claim 13, characterised in that at least the majority of the obliquely extending grooves (11) is made continuously curved.

15. Vehicle tyre in accordance with claim 1 or 3, characterised in that additional circumferential grooves (13), the width of which only amounts to a fraction of the narrow grooves (5) are provided in addition to the superwide groove (4) and to the grooves (5) which are narrow in comparison thereto.

FIG. 1

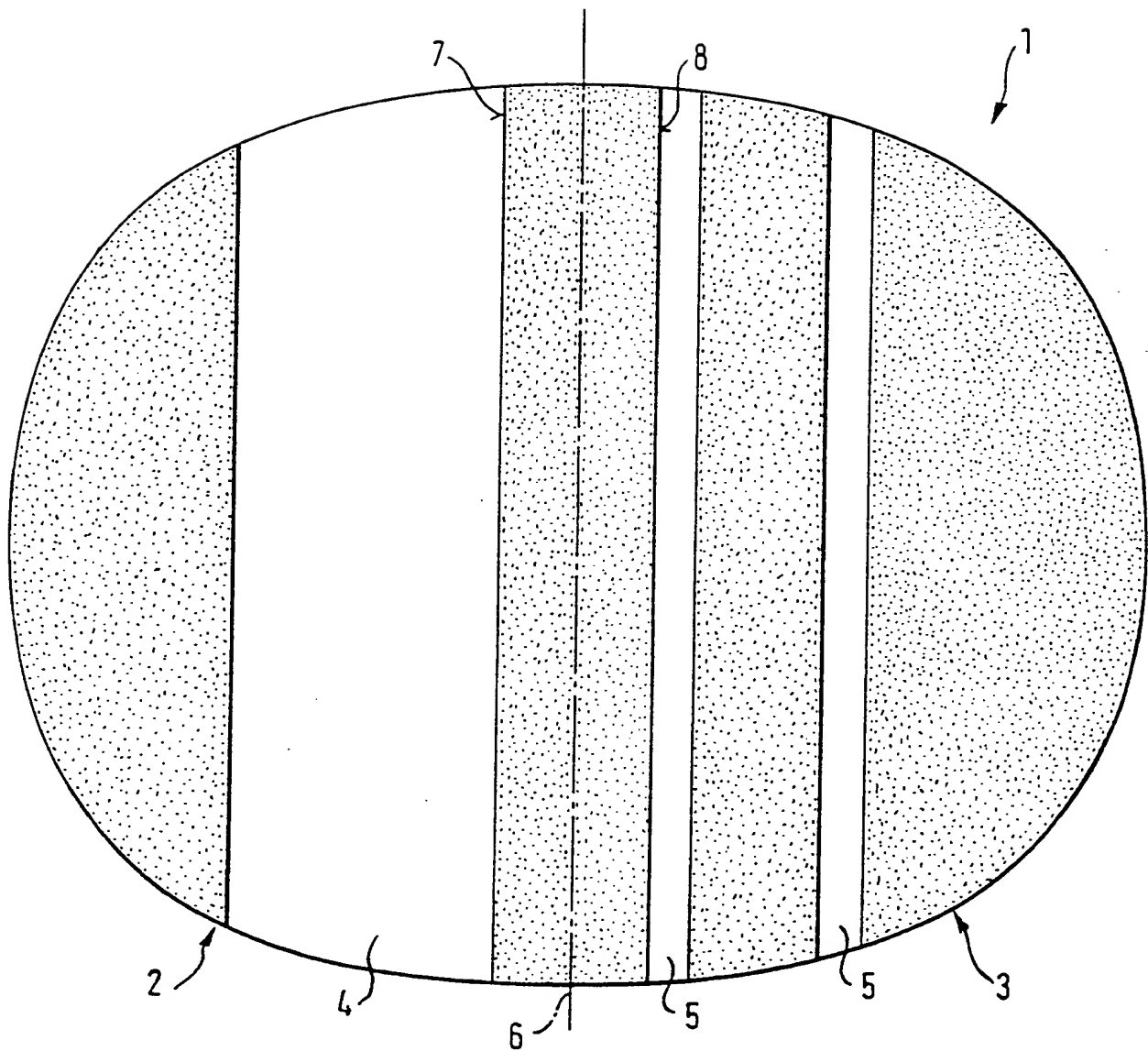


FIG. 2

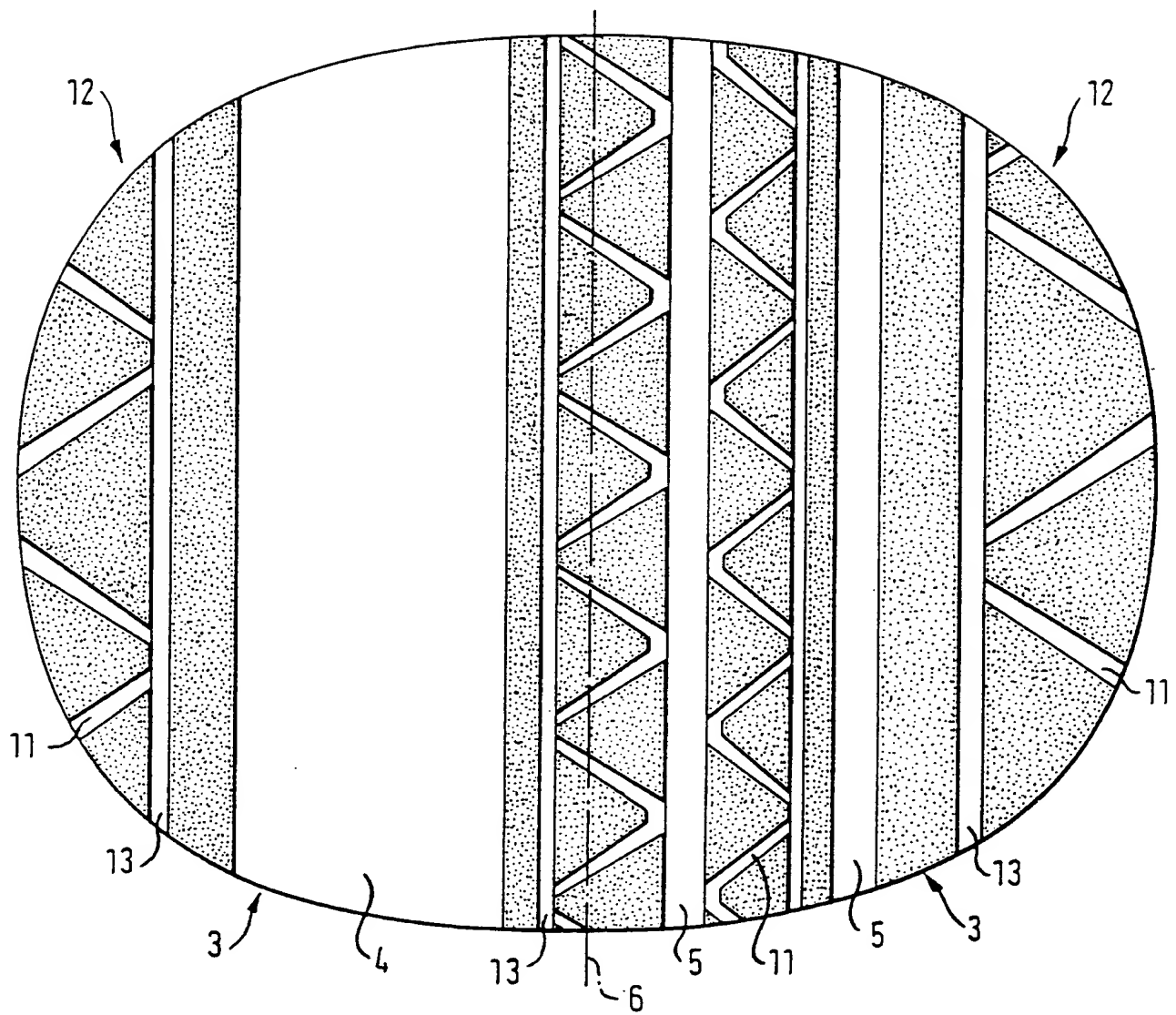


FIG. 3

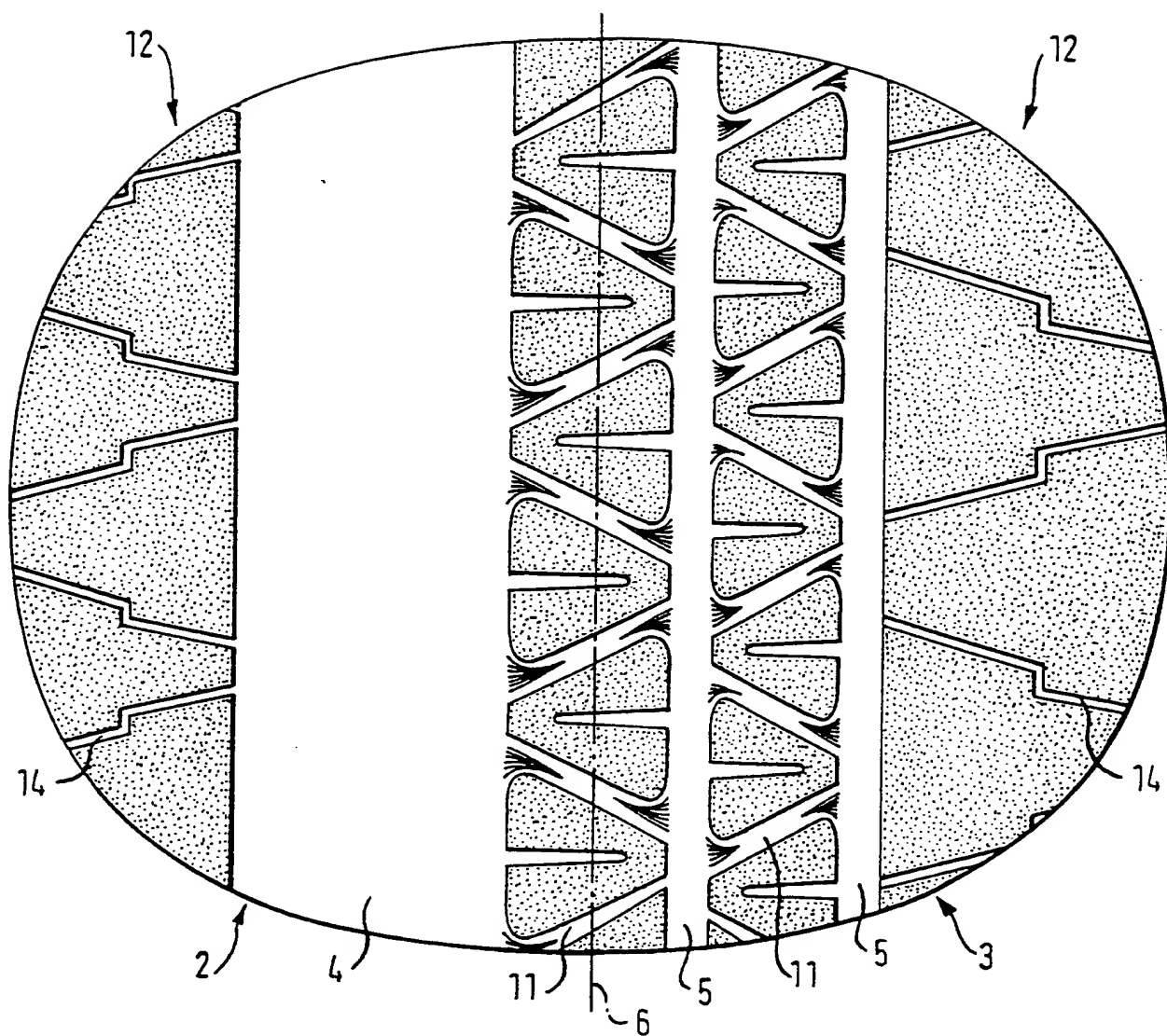
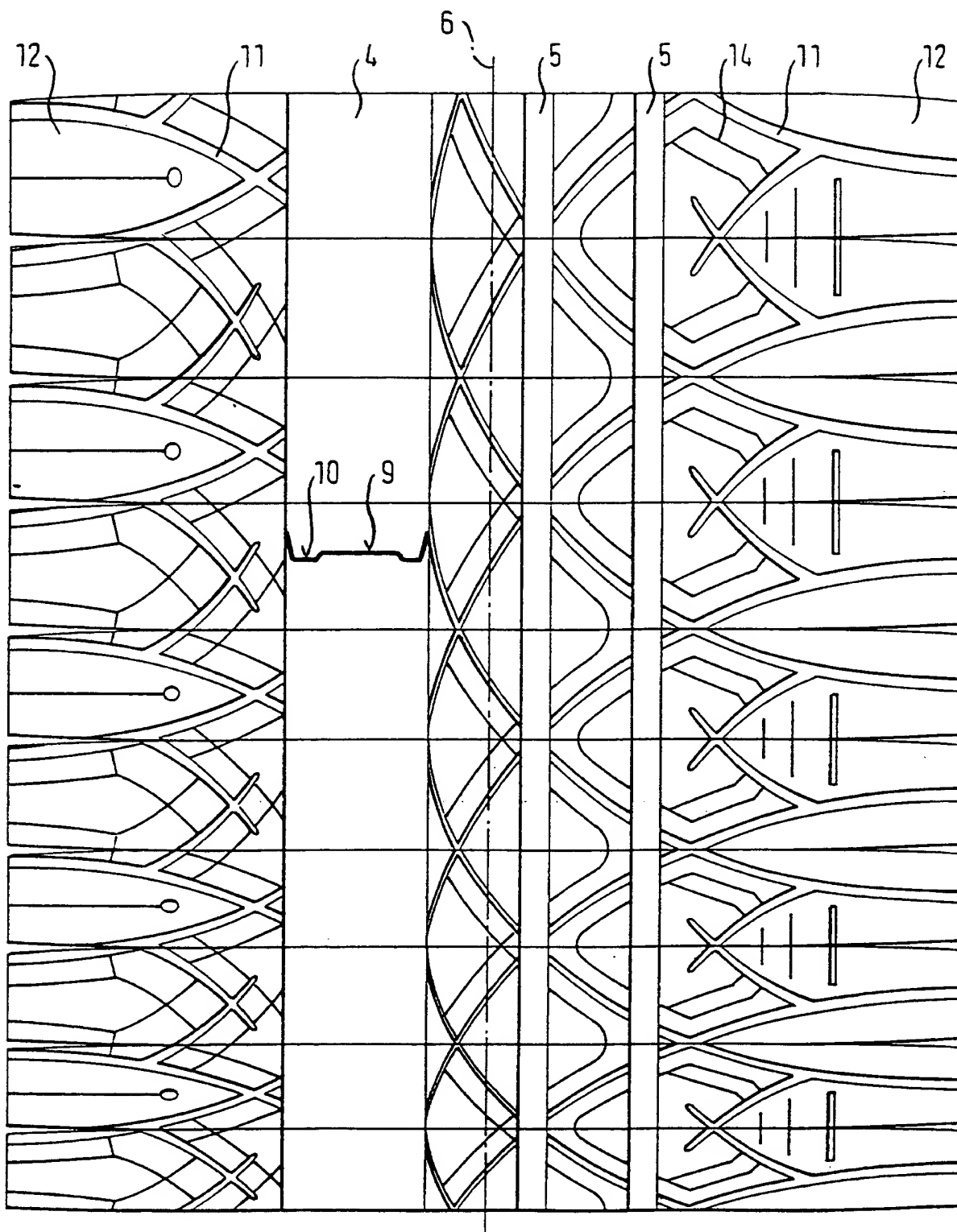


FIG. 4



INTERNATIONAL SEARCH REPORT

International Application No.

PCT/IB 00/01150

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B60C11/03 //B60C101:00, B60C111:00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B60C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 484 336 A (BRIDGESTONE TIRE CO LTD) 18 December 1981 (1981-12-18) claim; figure ---	1-4,6,9
X	EP 0 686 516 A (CONTINENTAL AG) 13 December 1995 (1995-12-13) column 4, line 36 - line 42 column 5, line 5 - line 24; claims 1,4; figures 2,3 ---	1-4,6,9
X	US 5 358 022 A (ATTINELLO JOHN S ET AL) 25 October 1994 (1994-10-25) column 5, line 28 - line 36 column 5, line 55 - line 62 column 8, line 59 - line 65; figure 5 --- -/--	1-4, 10-12,14



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

1st Application No

/IB 00/01150

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 687 037 A (REESE THORSTEN ET AL) 18 August 1987 (1987-08-18) column 2, line 2 - line 4; claim 1; figures ---	7,8
A	EP 0 402 595 A (UNIROYAL GOODRICH TIRE CO) 19 December 1990 (1990-12-19) column 3, line 55 -column 4, line 23 ---	5,10
A	US 3 286 756 A (W. ELLENRIEDER) 22 November 1966 (1966-11-22) column 4, line 22 - line 51 ---	1,10-12
A	US 4 546 808 A (FONTAINE JEAN F L ET AL) 15 October 1985 (1985-10-15) column 3, line 13 - line 25 -----	15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/IB 00/01150

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
FR 2484336	A	18-12-1981	JP 57004409 A AU 7107381 A CA 1159345 A	11-01-1982 24-12-1981 27-12-1983
EP 0686516	A	13-12-1995	DE 4420315 A DE 59501621 D ES 2115293 T JP 8048110 A	14-12-1995 23-04-1998 16-06-1998 20-02-1996
US 5358022	A	25-10-1994	US 5327952 A AU 646927 B AU 1212392 A BR 9200608 A CA 2054991 A EP 0503405 A JP 5092704 A MX 9200891 A TR 25971 A BR 9303901 A CA 2101862 A DE 69316299 D DE 69316299 T EP 0590526 A ES 2112941 T MX 9306044 A US 5386862 A	12-07-1994 10-03-1994 10-09-1992 10-11-1992 09-09-1992 16-09-1992 16-04-1993 01-09-1992 01-11-1993 19-04-1994 03-04-1994 19-02-1998 09-07-1998 06-04-1994 16-04-1998 29-04-1994 07-02-1995
US 4687037	A	18-08-1987	DE 3431655 A FR 2571311 A GB 2166095 A, B IT 1200726 B JP 1804890 C JP 5007201 B JP 61060304 A	13-03-1986 11-04-1986 30-04-1986 27-01-1989 26-11-1993 28-01-1993 28-03-1986
EP 0402595	A	19-12-1990	CA 2015225 A JP 3096408 A MX 173352 B	14-12-1990 22-04-1991 22-02-1994
US 3286756	A	22-11-1966	CH 433035 A DE 1505878 A FR 1424968 A GB 1019776 A GB 1091776 A	31-03-1967 22-05-1969 31-03-1966
US 4546808	A	15-10-1985	CA 1237053 A DE 3470704 D EP 0148721 A	24-05-1988 01-06-1988 17-07-1985